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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PS 3072 for a patent by MANUFACTURING SOLUTIONS PTY LTD as filed on 21 June 2002.

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Second day of July 2003

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PROVISIONAL SPECIFICATION

"Device for Guiding Flexible Packages into a Case"

The invention is described in the following statement:

DEVICE FOR GUIDING FLEXIBLE PACKAGES INTO A CASE

FIELD OF THE INVENTION

This invention relates to high-volume commercial packing processes and equipment. In particular, it relates to a device and procedure for sequentially guiding individual flexible articles into a case with efficient use of the space within the case and the articles oriented vertically within the case. The invention is particularly useful for moderate speed applications because of its extreme simplicity and hence low cost.

BACKGROUND OF THE INVENTION

Many technologies exist for the packing of flexible packages, particularly bags or pouches, into receptacles. Some machines place or drop the packages flat in the receptacle, others position the packages vertically within the receptacle. Most of the machines available to place bags or pouches in a packing case with a vertical orientation tend to be large, expensive and capable of high speed operation.

The trend in many areas of manufacturing including the food industry is for more frequent product changeovers with shorter production runs. A concurrent trend is to reduce the number of packages in a shipping container, while there is constant pressure to reduce the cost, size and complexity of equipment, improve the flexibility of equipment and simplify processes.

This invention relates to an apparatus for automatically packing cases or cartons with vertically oriented bags or pouches using a small, simple mechanism that is quickly changed to different production requirements and is inexpensive to construct compared to available high speed machinery.

The major application is the insertion of flexible bags or pouches in a single row in a case or carton with the bags or pouches standing on end so that the top of every bag or pouch is visible from above. The application is also limited to moderate speed applications up to perhaps 140 cycles per minute or more depending on the nature of the product. For some products, only a lower speed will be achievable. If two or more bags or pouches are inserted simultaneously in a cycle, then the number of items packed in a minute will increase correspondingly.

There have been numerous designs for machines to insert bags or pouches into cases such as those disclosed by Odenthal (U.S. Patent 4,676,050 and 5,588,285). These overlap the bags so that as one bag is loaded vertically into a case, the top of the bag is prevented from tipping forward into the empty section of the case by the bottom of the next bag. The mechanism to do this includes the end of a conveyor inserted into the case which when withdrawn from the case leaves an unused void in the case. A variant of this design is disclosed in German Patent document DE19917657 which has a similar problem of slack fill but fills the case in a different direction and uses different methods to prepare the group of bags to be loaded to the case.

A fast machine without the problem of slack due to a withdrawn conveyor is disclosed by Ferris (U.S. Patent 5,855,105). It is a considerably more complex and hence expensive machine. The machine relies on angling of the cases and gravity to encourage the bags to sit closely together and not fall into the area of the case still to be loaded.

Another much simpler design that uses a tilted case to encourage bags to remain in the orientation they are placed in is disclosed by Adamek (DE19742017). It is very simple, but relies on a bag flying from the end of a chute into a case and stopping in the required position in the required orientation. Furthermore, subsequent bags must find a stable position on the bags already loaded into the case and sufficient clearance must be left within the case for the last bag to enter reliably. Bags filled with liquid will tend to flex and conform to the interior of the case but bags containing solid materials are much less likely to do so solely under the influence of their own weight.

A slightly different approach is disclosed by Ryan (U.S. Patent 4,608,808) in which bags are individually conveyed into a tilted case on a retractable conveyor. This has the same problem of space required in the case for the conveyor which consequently can not be filled with product as applies to the concepts of Odenthal. It also requires the conveyor to be inserted and removed for each bag which will slow down the process.

A different approach is disclosed by Didier (EP1186537) where pouches are conveyed without grouping to special containers divided into a series of compartments. One pouch is dropped into each compartment with a subsequent process grasping the top of each of the individual pouches of a group prior to lifting the pouches out of the special container and placing them into a case.

Another approach disclosed by Heliot (U.S. Patent 3,425,184) guides individual bags into a cavity defined within a case by one end of the case, its bottom and sides and the previously loaded bag restrained at its top by part of the mechanism and at the bottom by a feature of the special case. After the bag has fallen into the void, it is pushed along the case to be similarly restrained before the next bag falls into position. A plate mounted on an angled roller prevents the previously loaded bags from falling into the unused part of the case. The design requires a special feature on the bottom of the case to restrain the lower end of the bag and also relies on a pusher to displace the bag beyond both the bottom feature and the top restraining member of the mechanism. The pusher design requires that the bag be quite stiff and the first bag loaded will be displaced the entire length of the case, following bags must move correspondingly shorter distances within the case.

To summarise, each of the above described systems uses one or more of the following described systems.

- A conveyor extends into the case which reduces the space available to be filled with bags (Odenthal, Ryan and DE19917657)

- Bags or pouches are transferred into a tilted case individually (Ryan, Adamek) and gravity is relied upon to keep the bags or pouches in place. The bags must form a stable stack within the case yet the case must have sufficient width for the bags to enter easily.

- A group of pouches is transferred into a case in a single operation which applies only to product that stacks neatly or else requires considerable machine complexity (Ferris). Many other machines are available to load cases but they tend to be complex and expensive, many are very fast and very reliable in operation.

- The product is placed into separate cavities in special receptacles to define their position prior to transfer to a case (Didier)

- The product is guided into a cavity within a case where one side of the cavity is defined by the end of the case and must then be displaced within the case to provide room for the next bag or pouch (Heliot). The case requires special construction details for this process to work.

SUMMARY OF THE INVENTION

In one aspect, the invention provides a method for guiding bags into a receptacle, including the steps of presenting a nominally four sided cavity within a receptacle, with said cavity partly defined on two opposing sides by members of the machine, and on the other two sides by the receptacle, into which cavity a bag may be guided without hindrance from bags already present in the receptacle, and after the said bag has moved into the cavity within the receptacle, some members of the machine move to re-create the cavity within the receptacle with the said bag now positioned in contact with the bags that have previously been loaded into the receptacle and restrained by one or more members of the machine which define the cavity, thus presenting another cavity into which another bag may be guided without hindrance from bags already present in the receptacle.

Preferably, the receptacle and the bags already guided into the receptacle are displaced by the movement of the members of the machine as the next cavity is presented, yet after a bag has passed down into the cavity, minimal motion of the bag relative to the receptacle will be required.

Preferably, the restraining of the bags already loaded into the receptacle will place the bags under compression and minimize gaps between the bags.

Preferably, when the last bag required to fill the receptacle with the desired number of bags has been guided into the receptacle, the members of the mechanism will relax their restraint on the bags, be withdrawn from the receptacle which will be removed and replaced with another empty receptacle, the members of the mechanism will enter this receptacle and form at least two sides of a cavity into which the next bag may be guided. The result is to create an empty cavity ready for the

next bag while also changing from a filled receptacle to an empty receptacle.

Preferably, this cycle of changing from the end of a filled receptacle to the start of the next empty receptacle will be completed in nominally the same time required for displacing a bag loaded into the cavity to the other side of a machine member with the cavity being re-created in the same receptacle. Therefore, no pause in the supply of bags or pouches to the machine is required for the change from the end of a filled receptacle to the start of an empty receptacle.

Preferably, the receptacle is a packing case or carton and the bag or pouch that is to be guided into the case is made of a flexible film and contains powder, articles or liquid and may also contain some air or other gas. The bag or pouch will have nominal dimensions but individual units will vary slightly, especially in thickness of the bag or pouch and the position of corners and edges which might even be folded back in some instances.

Preferably, the bags will be guided down into the case due to gravity rather than require a powered movement, with the bags falling from the end of a conveyor along an arc that will end in the cavity. The path of the falling bag is surrounded by surfaces to guide the bag but preferably the bag should not need much contact with these.

Preferably, the member of the machine that restrains bags already loaded to the case and also separates these from the most recent bag guided into the case, can be withdrawn sufficiently from the case so that the lowest extremity of the member is moved above the highest anticipated extremity of the said bag, then guided back into the case on the other side of the said bag with its downward motion concluding with the said bag and all bags previously loaded to the case and the case displacing sufficiently to position the said bag on the other side of the restraining member of the machine from the re-created cavity.

Preferably, the lower extremities of the restraining member are able to interleave within the lower extremities of the opposite member of the cavity so that no matter what the position of the top of the bag most recently guided into the cavity, the mechanism will always be able to place the lower extremities of the restraining member beyond the upper edge of the bag prior to moving down to create the cavity within the case for the next bag.

Preferably, the restraining member of the mechanism is able to relax its restraining rigidity as it withdraws from the case in the first part of the cycle, to minimize any tendency of said member to drag a bag up out of the case.

Preferably, the restraining member and opposing member of the mechanism that are inserted into the case to form two sides of the cavity are smooth plates that are essentially straight with deep notches in the lower end and supported relative to one another so that the lower ends of the plates may be interleaved without touching by pivoting the restraining member.

In an alternate embodiment, the restraining member and opposing member of the mechanism are rods that are essentially straight at the lower end and positioned and supported relative to one another on supporting frames so that the lower ends of the rods may be interleaved without touching by pivoting the restraining member.

Preferably, the member opposite the restraining member is pivoted and spring loaded to allow slight movement, and tapers the cavity towards its bottom to guide the lower edge of the guided bag to a position close to restraining member. When the restraining member moves, up, across, down and then back to displace the bag and the case, the bottom of the bag does not have to move as far and is less likely to wedge between the bottom of the case and the under side of the restraining member. The spring loading of the pivoting opposite member allows this member to move back to allow an unusually large bag to be guided to the bottom of the case without interrupting production. This positioning of the base of the bag within the cavity is especially beneficial for floppy heavy bags.

In an alternate embodiment, the bag or pouch may be comparatively stiff and slippery with at least some ability to stand upright supported only at the top. For such products, the restraining member need only restrain the upper part of the last bag or pouch loaded, while the lower extremity of the opposing member may be moved forward by an actuator or a spring to restrain the lower end of the last bag or pouch loaded, with the lower extremity of the opposing member being moved back by the mechanism to define the cavity shortly before the next bag or pouch drops into the cavity. This requires a shorter stroke of the restraining member which can be completed more quickly with a consequent higher maximum operating speed.

If the lower extremity of the opposing member is pivoted forward just before the bag or pouch reaches the bottom of the chute, this will apply pressure to the front and back faces of the bag or pouch to slow its fall and also reduce the tendency of the contents of the bag or pouch to move towards the bottom, which would reduce the tendency of the bag to become thicker at the bottom end.

The opposing member applies most of the force required to displace the last bag or pouch guided into the case and the case to create a cavity for the next bag or pouch. The shortened restraining member applies the force required to displace and restrain the upper edge of the bags.

In an alternate embodiment, the mechanism will have a sensor or sensors able to detect if the cavity formed is clear of any bag previously guided into the case. If the sensors detect a bag has not been correctly displaced to the other side of the restraining member, the displacement and cavity re-creation cycle may be repeated if there is sufficient time before the next bag is expected. Alternatively, the next bag could be diverted to a separate repository for subsequent hand packing by an operator to provide the machine sufficient time to clear the fault by repeating the cycle.

In an alternate embodiment, if a sensor or sensors detect that the cavity presented within the case for the next bag is obstructed and has not or can not be

cleared by repeating the normal machine cycle, the mechanism can withdraw from the case and in nearly all instances, the obstruction will be left behind. The next empty case is moved into place and the mechanism enters the said case, forms a cavity and will be ready to guide the next bag or pouch into the case. The previous case that has not been filled correctly may be removed to a different destination from normally filled cases, where it may receive attention from an operator.

Preferably, this process of detecting and clearing a mal-function of bag guidance will neither require stopping the supply of bags nor interrupt the packing of cases and will affect only a minimum number, usually one, of cases.

The core area of application of the present invention is food products packed in bags or pouches that are required to be packed on end within a case, which have sufficient weight to enable a falling bag or pouch to be guided with reasonable consistency and where insertion rates are not especially high but an automated packing method is desired. The invention is particularly suitable for food products because both the product packed and the package sizes may be changed regularly which places a premium on flexibility of operation and an ability to handle variable packages because the food product being packed will usually not assist in defining the shape of the package. Other areas of application will be apparent to persons skilled in the art.

In automating the guidance of bags, pouches or other flexible package forms into cases and the successive presentation of empty cases to replace filled cases, several criteria must be recognized and addressed. These criteria are;

1. The bags will tend to be irregular in shape, although the maximum size and especially weight will not vary widely because the weight and density of food products are usually tightly controlled. Therefore the process must be unaffected by normal variation. The present invention overcomes this by providing guided entry to the cavity within the case with the cavity dimensions set slightly larger than the largest bag expected. The restraining of the bags within the case after loading provides some compression of the bags which reduces the unused space within the case and removes the clearance provided by the cavity for the entry into the case for the individual bag. Restraining the bags with some compressive loading may also partly redistribute the contents of the bags for some products and thus increase the number of bags that can be reliably and consistently loaded to a defined length receptacle.

2. The position and curvature of edges and corners of the bags will be especially variable, some will be folded back, others will be completely straight and have maximum height, others will be between these extremes. The process should be unaffected by these normal variations. The separation of bags already loaded from the cavity by the restraining member to prevent interference with the bag entering the cavity, and the motion of the restraining member which rises above the highest edge of the last bag loaded into the cavity before interleaving with the opposing member to reach behind the said bag, both

provided by the invention, achieves this.

3. The case will have some variation of geometry, but this will be less than the expected variation of the bags. The design features of the present invention to manage variation of the bags will assist in avoiding any effect from variations of the case.

4. The filled bags are manufactured by processes that usually run at steady rates and a process to pack these into cases must be able to accept all the bags provided without requiring the process to start and stop. The process described of guiding bags into a case, then withdrawing both the restraining and opposing members from the filled case so that it may be removed and replaced with an empty case before both members resume the insertion of bags into cases should not require a pause in the supply of bags, except possibly for very high speed operation. The restraining member and the opposing member when raised are interleaved and can hold a bag, then guide this bag into the case when the members are inserted into the case. This allows the invention to operate with no requirement for providing a gap in the supply of bags which is a significant simplification.

5. Some case patterns require more than one row of bags in a case. If two or more bags can be placed on the conveyor across its width so that all the bags enter the guides into the case together, this requirement can be satisfied by the invention. There are other machines that will perform this task with specific control of each individual bag but they are usually much more expensive machines.

6. The bags will be provided at a rate that usually matches the capability of the bag or pouch making process and it is highly desirable that any process for automatically placing these bags or pouches into cases can run faster. The mechanism described with the restraining member withdrawing and then moving behind the last bag guided into the case and finally displacing the bag and case to provide the next cavity will have a limited peak speed although this will be fast enough for many of the standard methods of producing bags or pouches. There are other processes that can accept some types of bags and pouches at considerably higher speeds but these machines are substantially more expensive.

7. Machinery for packing bags or pouches into cases should be easily adjusted to run different sizes of product. The invention is easily adjusted for different sizes, partially because of its simplicity.

8. Operational reliability and production efficiency of packing machinery is very important. Simplicity of operation which assists rapid diagnosis of the cause of a problem, ease of adjustment and the ability to self clear many types of production blockage without stopping the machine and causing lost production are benefits of the invention. The extremely simple motions required of the bag (falling down a chute into a defined cavity, then being displaced slightly

within the case, and then being restrained within the case until the case loading is finished) provides improved reliability of operation and is a very important benefit of the invention.

The bag or pouch is required to fall reasonably straight and to be guided by the chute and the sides of the cavity as it falls, which can be done with very high reliability for most bags and pouches provided they have a little weight and reasonably smooth, slippery surfaces.

Unless the bag or pouch is heavy and collapses easily under its own weight, the small sideways displacement required as part of the cavity re-creation cycle will not cause problems. Even difficult bags can be managed at lower speeds.

The fall into the cavity and the small sideways displacement are the only two motions required of the bag or pouch. All other forces and actions of the packing process mimic the types of load that will be applied to the bags or pouches after the case or carton has been packed and is in transit to its final destination.

The minimal number of operations on the bag is an especially important feature of the invention because the fewer operations that must be performed on a bag, the less likely that one of these will cause a problem.

The invention in one embodiment is particularly applicable to lower cost installations for bags and pouches that are moderately stiff and so require only a small motion of the restraining member to restrain the previously loaded bags or pouches which allows higher speed operation.

The invention in another embodiment is particularly applicable to lower cost installations for bags and pouches that have very little stiffness and require contact from top to bottom to restrain the bags already loaded. A larger and hence slower motion is required but these products are usually either packed laid flat or hand packed if the bags must be vertically oriented in the case. This embodiment is also applicable for bags and pouches that are moderately or very stiff but will have a slightly lower maximum speed.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a general view of the mechanism with a conveyor for supplying product and a case positioned for loading

Figure 2 shows a partial cross section of the mechanism

Figure 3 shows a view of the mechanism from above

Figure 4 shows a cross-sectional end view in the direction A-A of Figure 2

Figure 5 shows a view of the restraining and opposing members aligned with one another that shows the relative proportions that enables interleaving

Figure 6a shows the restraining and opposing members of the mechanism at the start of the bag and case displacement and cavity re-creation cycle with a bag at the bottom of the cavity defined within the case by the mechanism

Figure 6b shows the restraining member partly raised with the lower edge still guided by the last bag to enter the cavity.

Figure 6c shows the restraining member fully raised with the lower edge positioned beyond the top of the last bag to enter the cavity. The separately supported flap mounted behind the opposing member to keep the end of the restraining member within the case when loading the last few bags is also shown in this figure.

Figure 6d shows the restraining member moving down behind the last bag loaded to the cavity prior to displacing it and re-creating the cavity

Figure 6e shows the restraining member at the end of cycle position with the cavity re-created with the last bag loaded into the cavity now on the other side of the restraining member. The case has also been displaced by a suitable amount.

Figure 7 shows both the restraining and opposing members in the raised position which allows the filled case to be moved away and another empty case placed beneath the mechanism

Figure 8 shows the interleaving of the restraining and opposing members when both are raised as in Figure 7.

Figure 9 shows an alternate embodiment for stiffer pouches that requires a shorter motion to displace a bag loaded to the cavity within the case so that an empty cavity may be very quickly presented to the next bag.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

It will be understood by those skilled in the art that the present invention can be implemented in a number of different ways. The preferred embodiment will now be described with reference to an alternate embodiment that is advantageous in certain circumstances.

Referring to Figures 1, 2, 3 and 4 of the drawings, a series of bags 2 containing product are shown on a conveyor 3. The bags 2 are bagged in a known manner by a bagging mechanism, not shown, and deposited on the conveyor 3 with the required orientation.

The bags 2 are conveyed to the end of the conveyor 3 where they enter the first part of the mechanism 1 by falling into a chute 4 which is tapered and guides and aligns the bags 2 as they fall towards the cavity 10. The dashed line 41 indicates the nominal path the bag 2 will follow as it falls to the bottom of the cavity 10. Below the chute 4, the cavity 10 is defined by the restraining member 5, the opposing member 6, the case 7 defines the bottom and lower sides of the cavity 10 within the case 7, with the side plates 8 and 9 defining the upper sides of the cavity 10. The side plates 8 and 9 provide a continuity of side guidance from chute 4 into the case 7 and hold the flaps 11 far enough out that the bag 2 can enter the case 7.

The side plates 8 and 9 are long enough and positioned so that provided the next case to be loaded has the long side flaps opened as it first moves beneath the side plates 8 and 9, these will then control the side flaps until the case has been filled and pushed clear (Figure 7). If the cases to be loaded have no side flaps, then either the side plates 8 and 9 are positioned with their lower edges just above the case so that no bag 2 will hit the upper edge of the case 7 or else the side plates 8 and 9 will be pivoted and moved by actuators not shown to lift clear of the case 7 when loading has finished and move down into the case 7 when the next empty case has moved into position, before the first bag is guided into the case.

The chute 4 can provide some guidance for the bags 2 but the bags 2 must be presented consistently on the conveyor 3. If the bags 2 are deposited on the conveyor 3 by a mechanism, this should provide sufficient consistency. For a different size of bag 2, it may be necessary to adjust the chute 4 or replace it with another.

The action of falling down the chute 4 provides the bag 2 with some momentum which assists the bag 2 in quickly reaching the bottom of the cavity 10. Figures 2 and 4 show a bag 12 at the bottom of the cavity 10.

Figure 2 shows the construction details of the mechanism 1. The restraining member 5 is attached by the hinge 21 to the arm 19 which is attached by the hinge 23 to the sub-frame 27. The sub-frame 27 may be moved in the direction 33 to increase the width of cavity 10, or moved in the direction 34 to decrease the width of cavity 10. These adjustments in the directions 33 or 34 are a means of adjusting the mechanism 1 to pack a different size of bag or pouch if the thickness of the bag or pouch is different.

The actuator 25 retracts to raise the restraining member 5 and extends to lower it. When the actuator 25 is extended and the restraining member 5 is down and pressing against the bags already loaded 29 to the case 7, the position of the restraining member 5 is determined by the adjustment screw 17 which also resists the reaction load from the bags 29. The adjustment screw 28 can vary the width of the cavity 10 but is more useful for adjusting the angle of the restraining member 5 when it begins to displace the bag 12.

When the arm 19 rotates up, the restraining member 5 rises and would stay nearly vertical if not for the spring 16. When the restraining member 5 first starts to

rise, the geometry of the mechanism ensures that the adjustment screw 17 immediately loses contact with the restraining member 5 and the spring 16 imposes little or no force on the restraining member 5. As the arm 19 continues to rotate up, the extension of the spring 16 and hence the force it applies to the restraining member 5 increases.

The opposing member 6 is connected by the hinge 20 to the arm 18 which is connected by the hinge 22 to the machine frame 26. The actuator 24 extends to lower the opposing member 6 and retracts to raise it when the case 7 has been filled so the filled case 7 can be removed and replaced.

When the actuator 24 is extended, the arm 18 is rotated down to its lowest position as shown in Figure 2 and the opposing member 6 is inserted in the case 7. The arm 18 is shown with an angle rather than horizontal in its lowered position because this allows the top of the opposing member 6 to begin moving partially horizontally when the opposing member 6 begins to rise from the case 7. This is necessary to avoid the near side of the chute 4. The forward position of the opposing member 6 is controlled by the adjusting screw 15 and the spring 14 acting together to define a taper of the cavity 10 which will deposit the bag 12 with its base very close to restraining member 5. The spring 14 is comparatively soft so that a falling bag 2 can deflect the opposing member 6 to widen the cavity 10 if necessary.

The adjustment screw 28 which acts against the outside of the chute 4 limits the movement of the opposing member 6 so that it can support both the bag 12 and the restrained bags 29 for part of the mechanism cycle. The adjustment screw 28 also helps control the position of the opposing member 6 as the actuator 24 retracts and extends.

The plate 31 which is mounted on separate hinges in line with or behind hinge 20 and swings freely, is needed when inserting the last few bags in a case. It must protrude into the case 7 proper, below the fold line of the end flap. Figure 6c shows it deflected as the restraining member 5 moves beyond the top of the bag 12 to be displaced as part of the cavity re-creation cycle. For the second and possibly third last bag 2 to be loaded to the case 7, the ends of the restraining member 5 may extend beyond the end of the case 7. The bottom of the plate 31 will be restrained by the end of the case 7 and so the plate 31 guides the ends of the restraining member 5 down and into the case 7.

Figure 3 shows the clear path for the bag 2 to travel down into the chute 4 and hence into the cavity 10. Figure 4 shows a bag part way down and not touching the sides of the chute 4. This is the normal path the bag 2 should follow. Figure 4 also shows a bag 12 at the bottom of the cavity 10. In normal operation, this bag 12 would have to be at least part way through the bag displacement and cavity re-creation cycle as shown in Figure 6. If the mechanism was in the position shown in Figure 6c or later in the cycle, the bag shown falling in the chute 4 would be processed correctly.

Figure 5 shows both the restraining and opposing members of the mechanism

as they are aligned when the cavity 10 is presented. The long extensions of the lower end of both members 5, 6 are proportioned so that the restraining member 5 may interleave with the opposing member 6. Figure 8 provides a view of this interleaving when both are raised for the removal of a filled case and its replacement with an empty case. As shown in Figure 5, the restraining member 5 has 4 extensions and is slightly less wide than the bag 12 and the case 7.

If a wider or narrower bag is to be packed, the positions of the side plates 8 and 9 must be altered and the restraining member 5 and the opposing member 6 may need to be replaced with wider or narrower plates. The mechanism will function correctly for a moderate range of bag widths without requiring that the restraining member 5 and the opposing member 6 be changed.

As the length of the bag 12 reduces and the depth of the case 7 also decreases, no change to the restraining member 5 or the opposing member 6 would be needed but the side plates 8 and 9 may need to be changed or repositioned appropriately.

Although a large mechanism 1 could be adjusted to run very small product, its heavier weight would limit its maximum speed to less than a smaller mechanism 1 could achieve.

The opposing member 6 has three extensions and is narrower. The opposing member 6 must guide the falling bag 2 and then support it as bag 12. For part of the bag displacement and cavity re-creation cycle, the opposing member 6 must also provide support for the other bags 29 already loaded to the case 7. The restraining member 5 must displace the bag 12, the other bags already loaded 29 and the case 7 at the end of the bag displacement and cavity re-creation cycle. The restraining member 5 should support as much of the bag 12 as possible and have only a small clearance between the outside perimeter of the restraining member 5 and the inside of the case 7 to minimize any opportunity for a bag 12 to move around the restraining member 5 rather than be displaced by it. The case 7 may also require outside support (not shown) of the case sides so that these do not bulge.

When the bag 12 has reached the bottom of the cavity 10, the bag displacement and cavity re-creation cycle can begin. This is shown in Figures 6a, 6b, 6c, 6d and 6e. Figure 6a shows the bag 12 at the bottom of the cavity 10 with the restraining member 5 in its wait position. Figure 6b shows the restraining member 5 partially withdrawn from between the bag 12 and the restrained bags 29. The spring 16 applies little or no loading to the restraining member 5 during the initial part of the cycle to allow the restraining member 5 to float freely and apply minimal force to either of the bags it is touching, thereby minimizing any tendency to pull these bags up with the restraining member 5. The upward motion due to rotation of the arm 18 caused by retraction of the actuator 25 should be very rapid and the surfaces of the restraining member 5 should be very smooth to further minimize any tendency for the restraining member 5 to pull a bag up out of the case 7 .

Figure 6c shows the restraining member 5 after it has been fully withdrawn

from between the bag 12 and the restrained bags 29. The spring 16 which is very lightly loaded initially, starts to apply more force to the restraining member 5 as the arm 19 is raised higher which will move the extremities of the restraining member 5 to interleave with the opposing member 6. If the upward motion of the arm 19 which supports the restraining member 5 is rapid, inertial effects will act in unison with the spring 16 to position the restraining member 5 as shown in Figure 6c when the bag 12 is not close to the end of the case 7.

In Figure 2, the plate 31 is shown mounted behind the opposing member 6 and also pivoted from the arm 18. It is deflected by the extremities of the restraining member 5 except when the case is nearly full. The lower edge of the plate 31 is below the level of the flaps of case 7. When the restraining member 5 is in the part of the bag displacement and cavity re-creation cycle shown in Figure 6c, the extremities of the restraining member 5 will protrude beyond the opposing member 6 and may protrude beyond the end of the case 7, and could catch on the upper edge of the end of the case 7 during the downward stroke of the restraining member 5. The plate 31 will contain the extremities of the restraining member 5 within the limits of the case and avoid this problem for the mechanism 1 as shown.

Figure 6d shows the restraining member 5 moving downwards beyond the bag 12. The actual position of the restraining member 5 will be a combination of the force applied by spring 16, the effects of gravity and inertial loadings on the mass of the restraining member 5, the position of plate 31 (if close to the end of the case 7) and the positions of the arm 19 and the adjustment screw 17. At some point in this part of the motion, the restraining member 5 will contact the bag 12 with sufficient pressure to overcome all factors other than the position of the arm 19 and the adjustment screw 17.

The adjustment screw 17 should be adjusted so that the restraining member 5 is vertical or nearly so when the restraining member 5 begins to apply pressure to bag 12 to displace it and the case 7 so that the cavity 10 may be re-created for the next bag to be guided into the case.

The arm 19 and hence the restraining member 5 will continue to move a little further as the bag 12 is displaced but the position of the hinge 23, the geometry of the arm 19 and the relative position of the restraining member 5 should apply a predominantly horizontal loading to the bag 12 to move it, the other bags 29 and the case 7, the displacement 30 shown in Figure 6e at which point bag 12 becomes one of the restrained bags 29.

The case restraint 32 applies pressure to the end of the case 7 during the filling process to prevent the case 7 from continuing to move after the restraining member 5 has finished displacing the last loaded bag 12, the restrained bags 29 and the case 7. The case restraint 32 can function in two ways. If the case restraint 32 only resists movement in the direction shown by the displacement 30, the case 7 will not move when restraining member 5 is withdrawn during the bag displacement and cavity re-creation cycle.

If the case restraint 32 applies a constant pressure, the case 7 will move backwards when the restraining member 5 is withdrawn during the bag displacement and cavity re-creation cycle. The case restraint 32 will transfer its force to the case 7, to the restrained bags 29, to the bag 12 and thus to the opposing member 6 and will move the opposing member 6 until adjusting screw 28 acting on the back of the chute 4 stops the motion. This has two consequences which may be desirable when packing some products, the case 7 and the restrained bags 29 will oscillate slightly back on every cycle which may help to redistribute the contents of the bags 29 for some materials so that more bags 2 can be loaded to the case 7. The compression of the bag 12 by the bags 29 before the restraining member 5 begins to displace the bag 12 will improve the reliability of operation for some types of bag.

The pneumatic cylinder 25 is shown defining the lower position of the restraining member 5 in combination with the adjustment screw 17. The amount of upward travel required for the restraining member 5 to clear the top of the bag 12 or to clear the end flap of the case 7 when changing cases may be different. The longer stroke can be used on every cycle but this will be slower. An actuator or actuators with 3 positions may be used. If the intermediate position required to clear the top of the bag 12 can be sensed, switching the valve for the cylinder 25 to change to the downward stroke may be the simplest, most reliable and easily adjusted configuration.

For an end of case retraction, the cylinder 25 would be allowed to retract fully to raise the restraining member 5 high enough to clear the end flaps of the case 7. Not all cases will have an end flap.

The positioning of the bottom of the bag 12 close to the bottom of the restraining member 5 may impart a slight tilt to the bag 12 so that the restraining member 5 will begin to move the bag 12 later in the bag displacement cycle with less downward movement and predominantly horizontal movement. If the bag 12 is both heavy and sags within the cavity 10, the initial tilted position greatly reduces any tendency for the bag 12 to stick to the bottom of the case 7 and jam underneath the restraining member 5 rather than be displaced by the restraining member 5 at the end of its cycle. The reason this initial positioning helps to avoid the problem is that it minimizes the distance the bottom of the bag 12 will be moved as well as predisposing the bag to slide in the direction required. For stiffer or lighter bags, the bag 12 will be very easy to displace with the restraining member 5.

For heavy bags that sag, a stiffer spring 14 for the opposing member 6 will help to support the bag 12 within the cavity 10.

Figure 7 shows the restraining member 5 and the opposing member 6 in the retracted up position that allows a filled case to be removed and the next empty case to be put in place. The figure also shows the interleaving of the lower part of the two plates.

Figure 8 is a view of the restraining member 5 and the opposing member 6 when both are raised as in Figure 7 showing the interleaving.

Figure 9 shows an alternate embodiment suitable for faster operation with stiff, slippery bags or pouches. The restraining member 35 is shorter and its motion during the bag displacement and cavity re-creation cycle will be less which allows faster operation. The cavity 10 relies upon the last bag loaded 38 to form one side of the cavity 10. The cycle requires a smaller but similar movement of the restraining plate 35 to displace the top of the bag 12. The displacement cycle also requires a driven movement of the opposing plate 36. The bottom of the bag 12, the restrained bags 29 and 38, and the case 7 are displaced by the bottom of the opposing plate 36 moving from the position indicated by the dotted outline 39 to the position shown. The cavity 10 is fully defined just before the bag 2 reaches the case 7 by the actuator 37 extending to move the lower extremity of the opposing plate 36 to the position indicated by the dotted outline 39. Spring 14 must be very stiff because it provides the force to displace the bags 12, 29 and the case 7 and then maintains restraint on the bags 29 through bag 38. When the bag 12 has been moved, it becomes bag 38 and forms one side of the cavity 10.

The arm 19 is shorter and the dotted line 40 indicates the movement downward of the restraining member 35 during the displacement of the bag 12 as it moves to become bag 38. If the arm 19 were as long as shown in the earlier figures, the restraining member 35 would have to be longer to be certain of always engaging on the other side of the bag 12 which would require a longer and hence slower movement of the restraining member 35.

Further increases in the speed of the mechanism could be realized using cams or four bar linkages, possibly with servo control, to allow very rapid controlled movements with smaller acceleration loadings than are feasible with the simple mechanism actuators shown.

Persons skilled in the art will perceive additional modifications and embodiments of the invention that nevertheless fall within the claims.

Figure 1

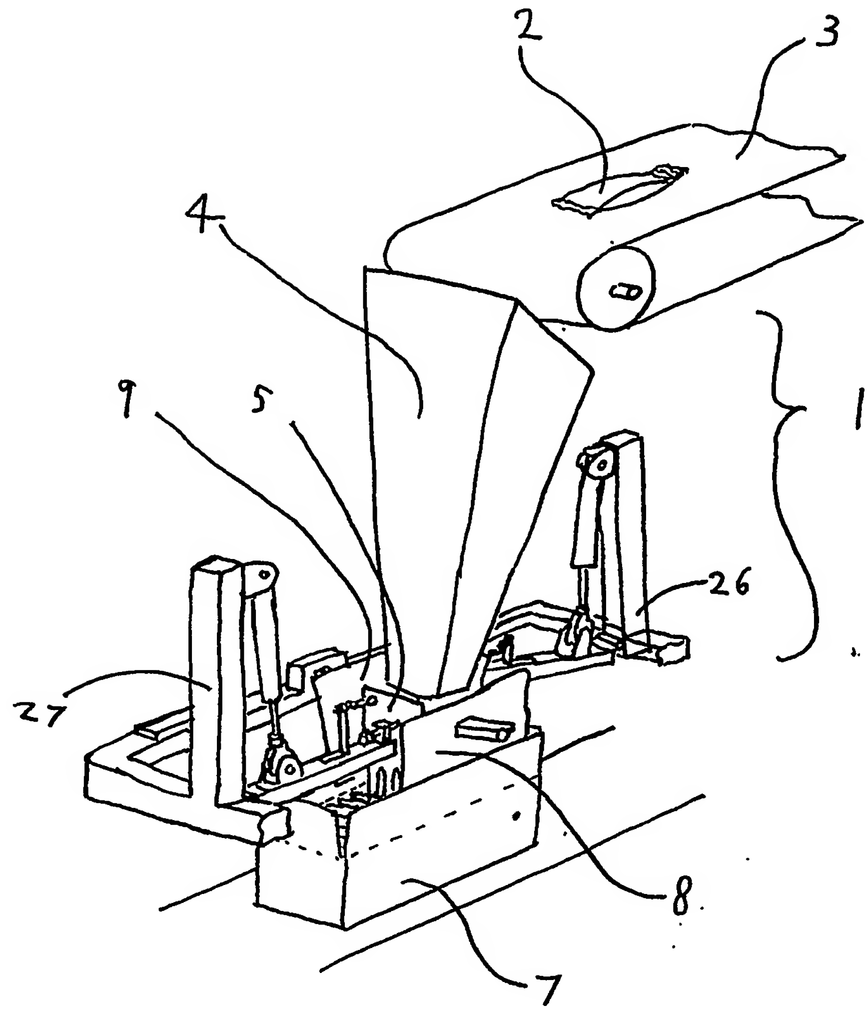

Figure 2

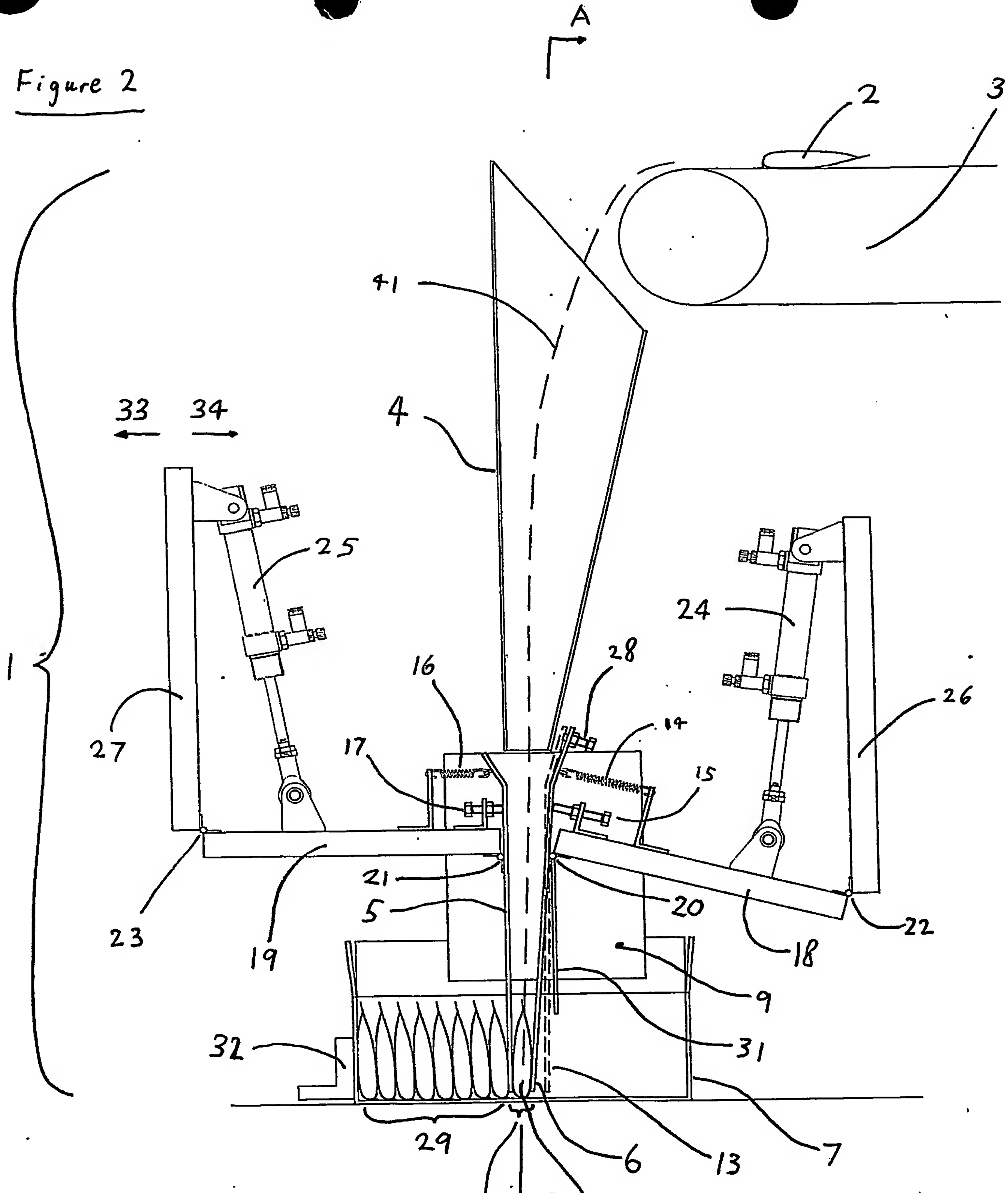

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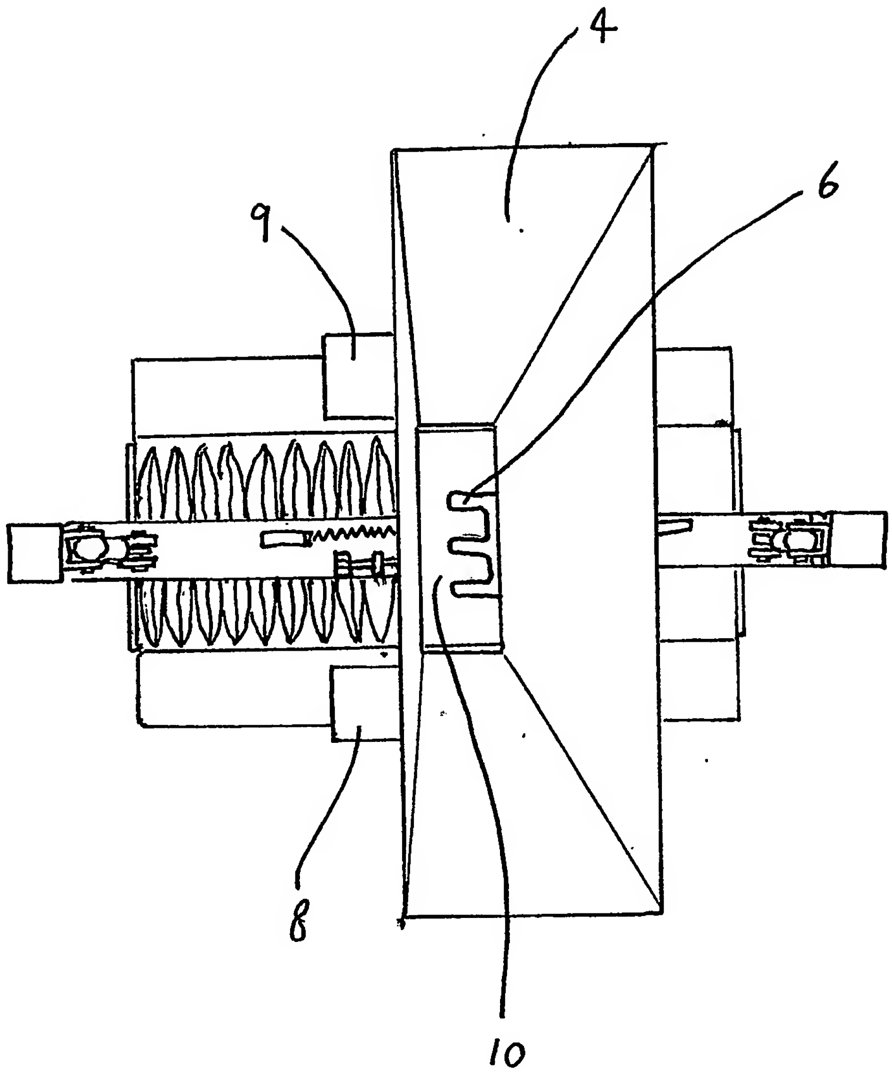
Figure 3



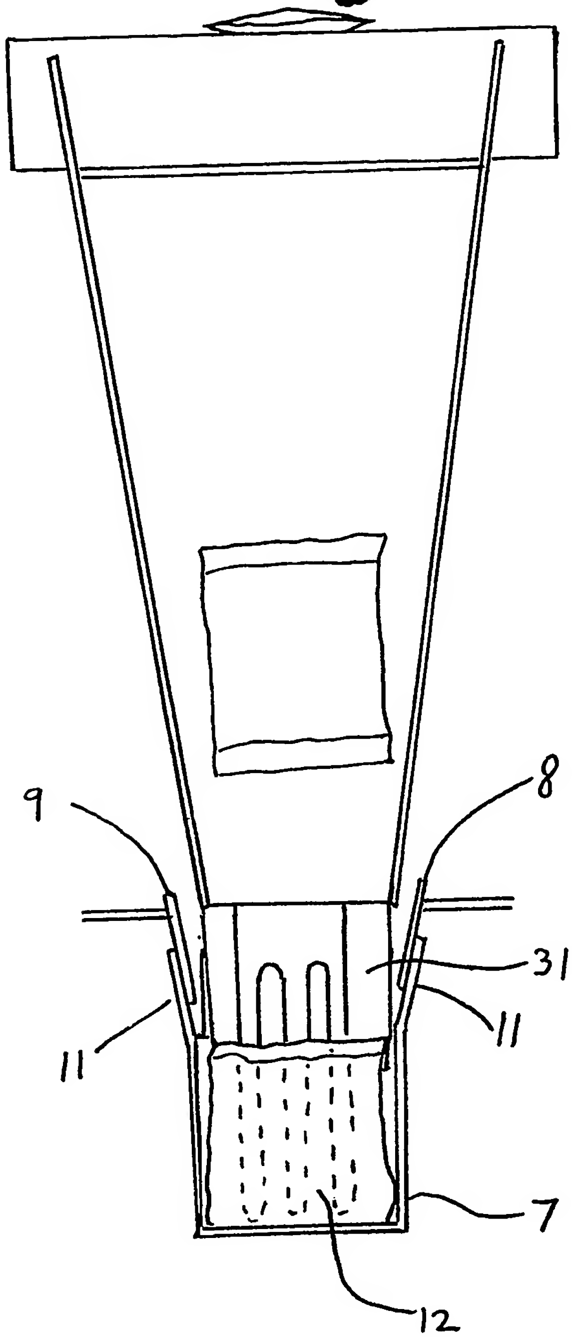


Figure 4

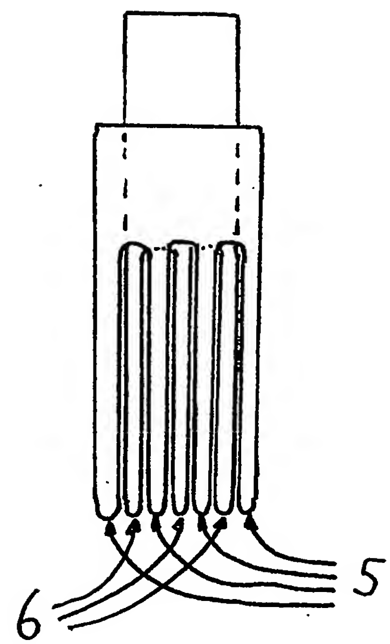
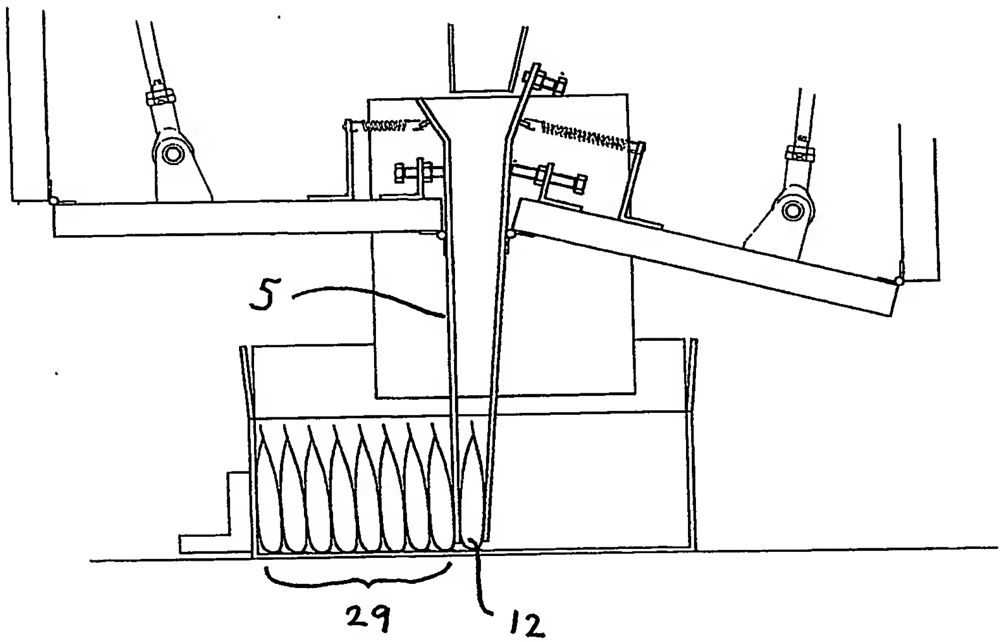


Figure 5

Figure 6a



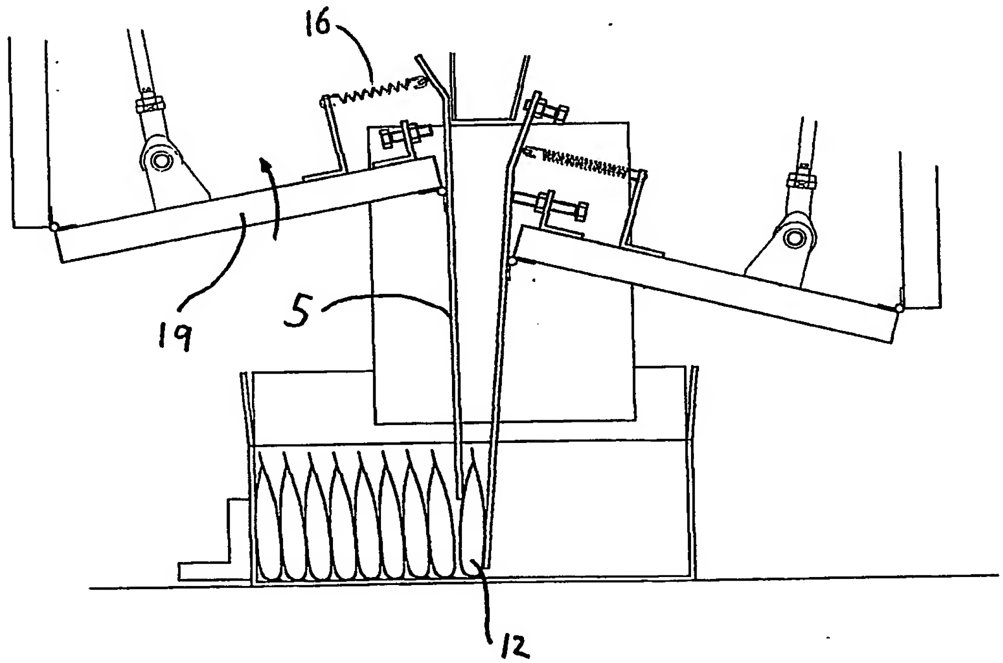
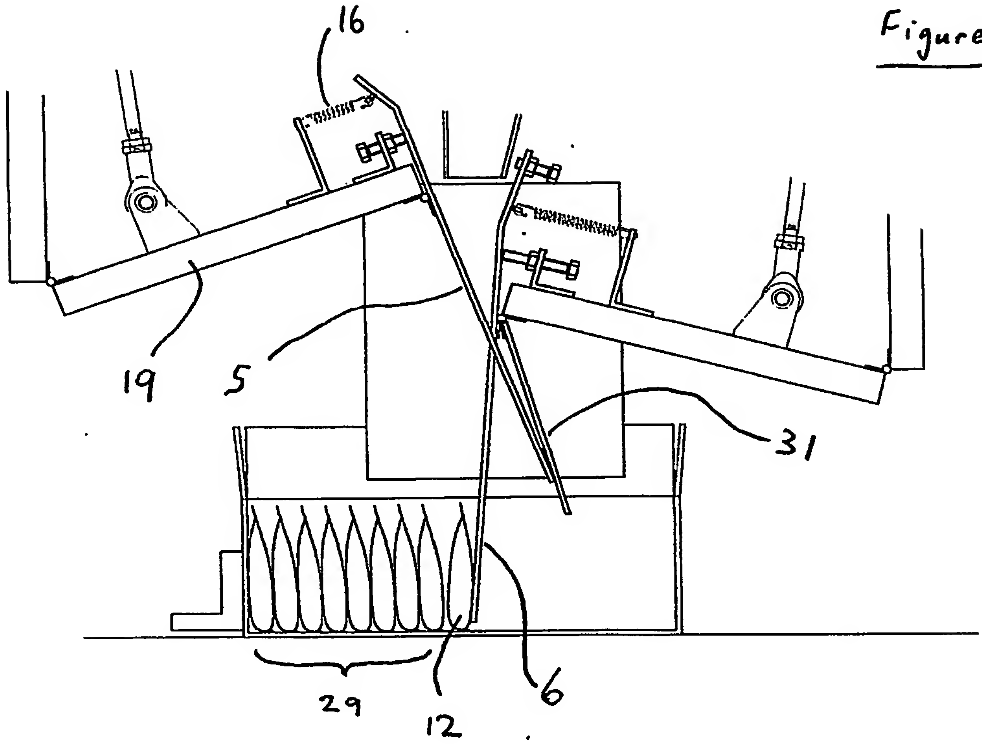


Figure 6b

Figure 6c



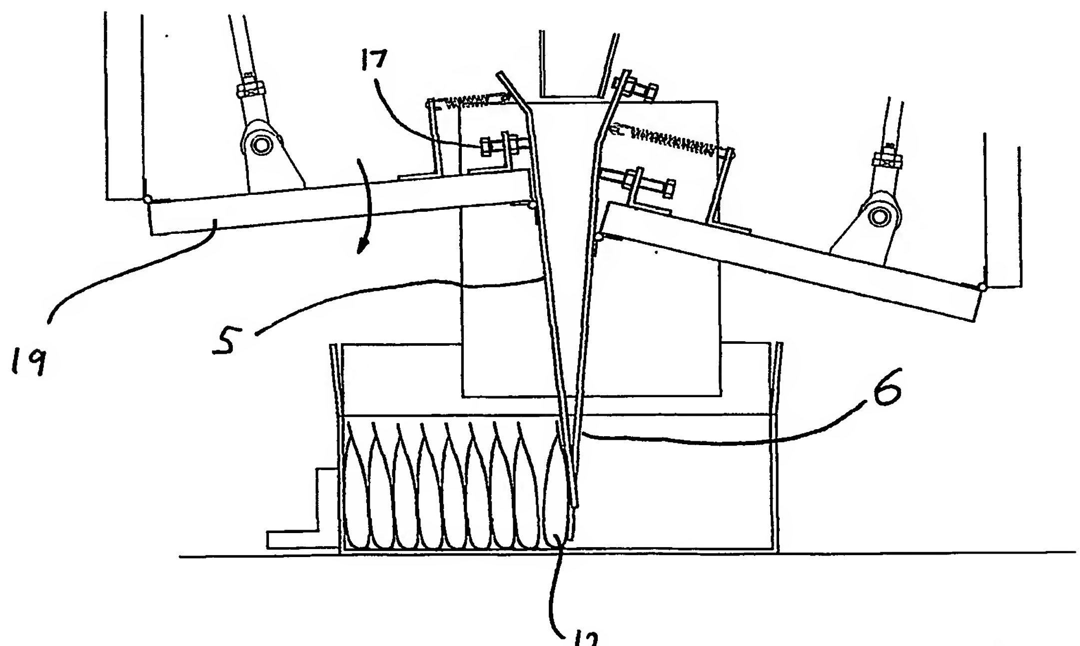
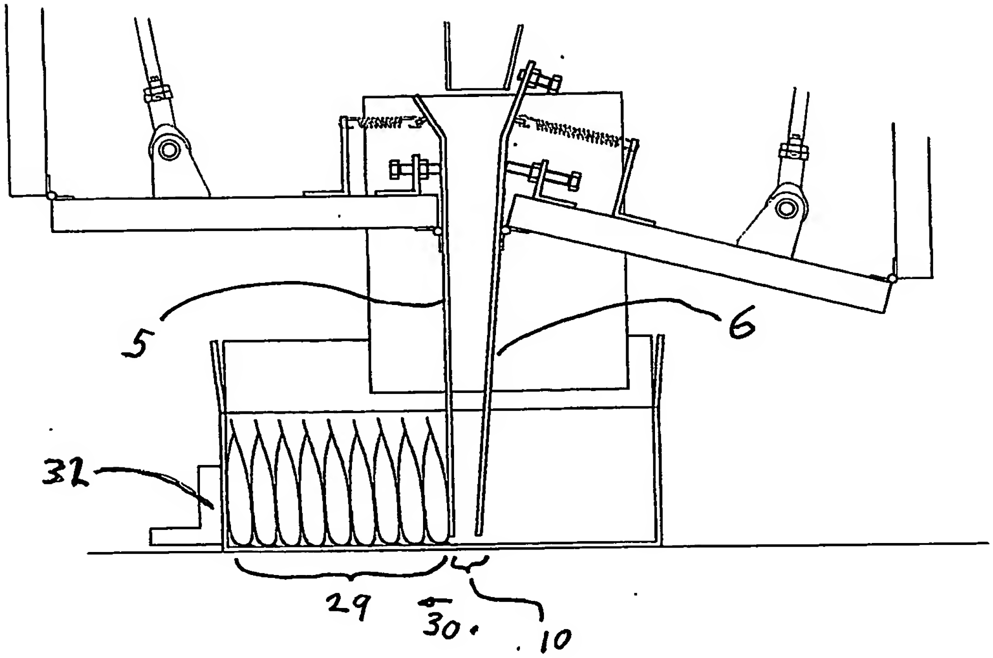


Figure 6d

Figure 6e



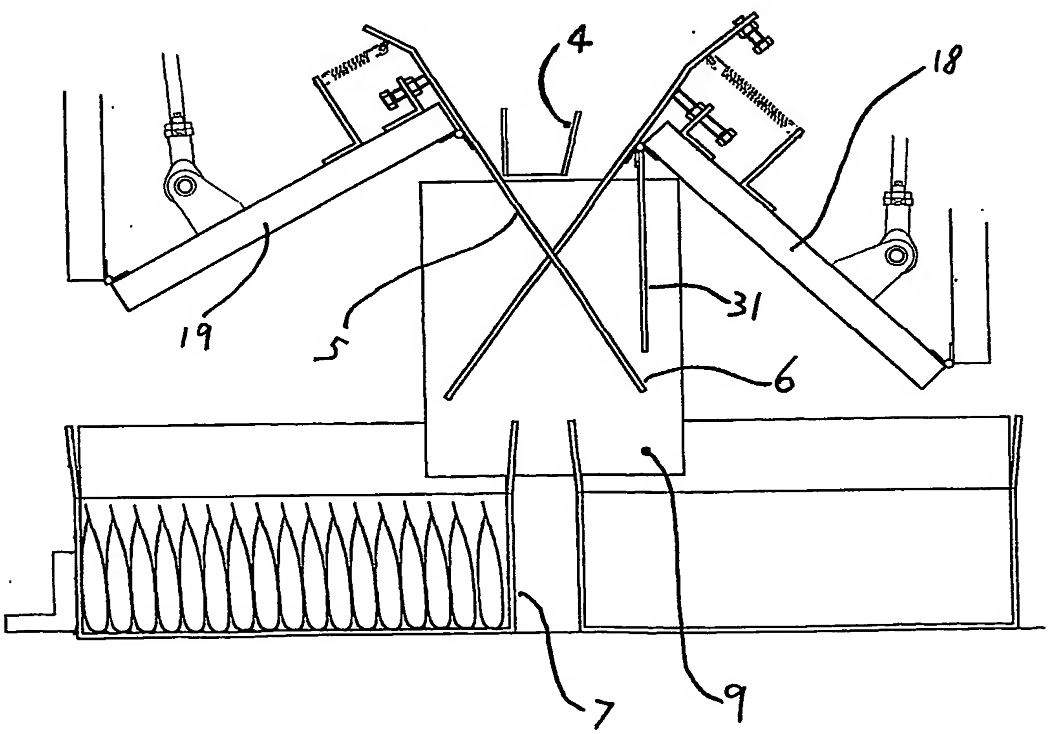


Figure 7

Figure 8

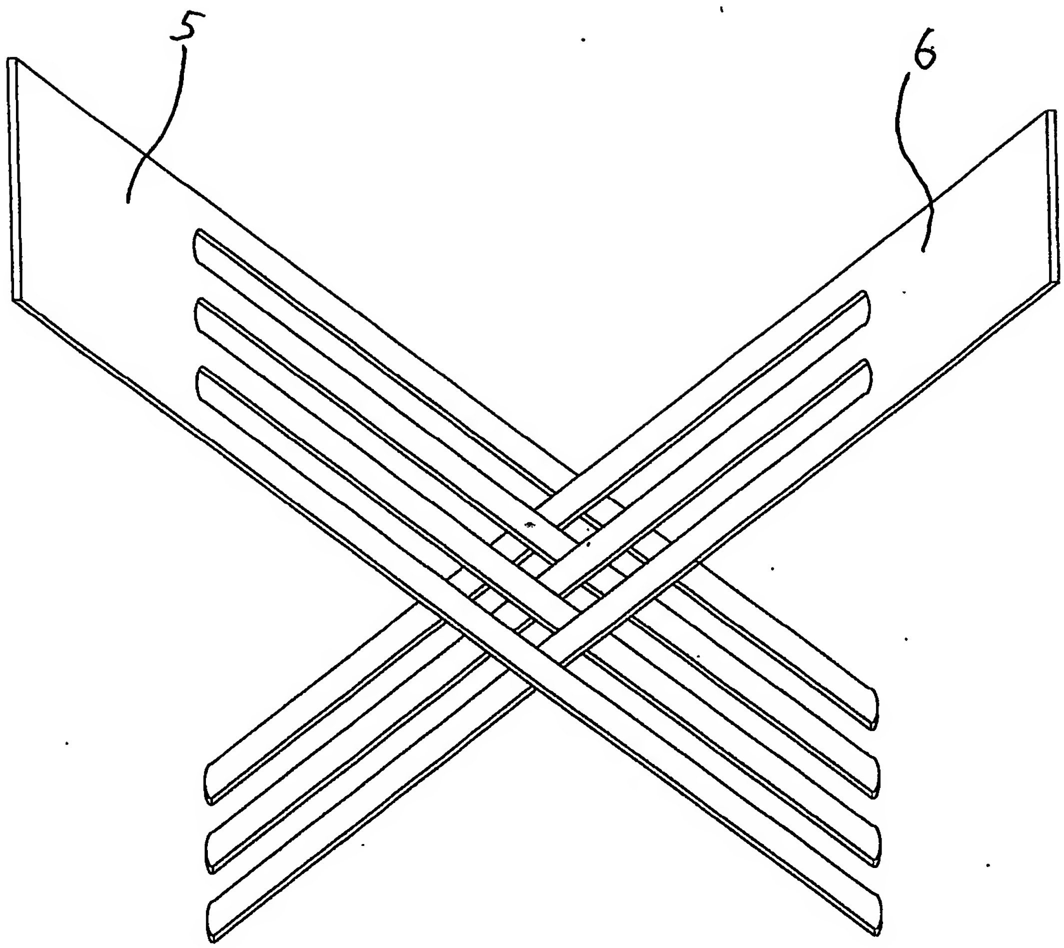


Figure 9